Diet Selection, Forage Quality, and Forage Availability: Could Forage Limit Moose Populations in Northern Idaho?

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By

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Authorization to Submit Thesis

This thesis of Thomas V. Schrempp, submitted for the degree of Master of Science with a Major in Natural Resources and titled "Diet Selection, Forage Quality, and Forage Availability: Could Forage Limit Moose Populations in Northern Idaho?," has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

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Abstract

Several populations of Shiras moose (Alces alces shirasi) in northern Idaho have declined in recent decades for unknown reasons. Limitations in quality or quantity of forage have been proposed to drive or contribute to these declines, but relatively few data are available to assess this hypothesis. To fill this information gap, we evaluated diet selection, analyzed forage shrubs for nutritional quality, conducted field sampling to model forage availability, and looked for evidence of forage limitations. Moose in northern Idaho exhibited greater selection for forage species that are of moderate to high quality and highly available on the landscape. Variation in predicted forage quantity among GMUs was correlated with variation in indices of population performance. Results suggest that forage is an underlying factor in moose population performance trends observed across northern Idaho. This information can be used to shape forest management strategies and harvest recommendations, and to direct future research into proximate factors influencing Shiras moose throughout their range.

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Dedication

I dedicate this work to my late friend Lavon Bradley (L.B.) Ellis. A true lover of nature, the time and thoughtful conversation we shared over many summer days at Mystic Meadow taught me to see and appreciate beauty in all things.

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Introduction

Forested lands in the western USA have undergone marked shifts in management and condition over the past century with broad implications for wildlife habitat and forest ungulates. Timber harvest has a long history on national forests, and indeed, the Organic Act of 1897 specifically includes direction to "furnish a continuous supply of timber". Timber harvest typically increases forage for ungulates by increasing the availability of light, water, and nutrients for understory vegetation (Riegel et al. 1992). Passage of The Multiple Use-Sustained Yield Act of 1960 signaled growing recognition of non-utilitarian and social values of national forests (Koch and Kennedy 1991) and a general decline in timber harvest in western states (Cook et al. 2016, McIver et al. 2014, McIver et al. 2013, Simmons et al. 2016). Research on ungulates has shown that forest management practices can alter forage quantity (Edenius et al 2013, Milner et al. 2013, Long et al. 2008a), quality (Wam et al. 2016, Burney and Jacobs 2011, Long et al. 2008a), and habitat use (Heinze et al. 2011, Long et al. 2008b).

In addition to timber harvest practices, policies regarding management of forest fires also affect wildlife habitat. Fire suppression in the northern Rocky Mountains became effective in the 1930s, reducing the extent of forest fires on national forests, even within large wilderness areas (Brown et al. 1994). Fire is an important ecosystem process that increases early-seral vegetation (Leege and Hickey 1971, Merrill et al. 1982, Arno et al. 1985) that provides forage for ungulates such as moose (*Alces alces*, Peak 1974), mule deer (*Odocoileus hemionus*, Long et al. 2008a, Hobbs and Spowart 1984), and elk (*Cervus*

elaphus, Long et al. 2008a, Sachro et al 2005). Changes in forest management practices, including fire suppression and reduction of timber harvest, have the potential to reduce forage quality and quantity, and thereby impose nutritional limitations on wildlife that forage on early-seral stage plants.

Nutrition affects many components of individual fitness and ultimately population dynamics for numerous ungulate species. Evidence of inadequate nutrition limiting adult or juvenile mass gain has been reported for caribou (*Rangifer tarandus;* Crete and Huot 1993), elk (Cook et al. 2004), roe deer (*Capreolus caperolus*; Gaillard et al. 1996), mule deer (Tollefson et al. 2010), and moose (Bo and Hjeljord 1991, Saether and Heim 1993, Milner et al 2013). Pregnancy rates also have been linked to nutrition and body condition for mule deer (Tollefson et al. 2010), elk (Cook et al. 2001), caribou (Cameron et al 1993), and moose (Ruprecht et al. 2016). In addition, body mass and body condition of neonates, juveniles, and adults have been correlated with survival for caribou (Cameron et al. 1993), bighorn sheep (Festa-Bianchet et al. 1997), elk (Cook et al. 2004, Bender et al. 2008), and moose (Solberg et al. 2004, Hand et al. 2012).

Adequate nutrition is a key factor influencing population dynamics, and there is growing evidence that summer nutrition is especially important for ungulates. The role of summer nutrition in regulating reproduction and survival has been documented for elk (Bender et al. 2004, Cook et al. 2004, Cook et al. 2001), mule deer (Tollefson et al. 2010), and caribou (Crete and Huot 1993), and the same trend has been observed for moose through twinning rates (Franzmann and Schwartz 1985), recruitment (Monteith et al. 2015), and survival (Sand et al. 2012). High spring temperatures and hot and dry summers were correlated with more rapid forage phenological development, decreased forage quality, and

reduced weight gain of moose calves and adults in Norway (Bo and Hjeljord 1991, Solberg et al. 2004). Likewise, recruitment of moose in Wyoming, Utah, and Colorado was reduced by increased spring-summer temperatures, increased rates of green-up, decreased spring-summer precipitation, and shortened springs, presumably due to shortened periods of availability and reduced quality of forage (Monteith et al. 2015). If summer nutrition is inadequate, females can exhibit delayed age at first reproduction and reproductive pauses (Albright and Keith 1987). In addition to needing adequate nutrition for pregnancy and lactation, females also must recoup body mass lost over the previous winter in preparation for the coming winter (Schwartz and Renecker 1997). Failure to recover sufficient fat reserves can predispose individuals to mortality from diverse proximate causes, such as predation (Sand et al. 2012) or parasites (Lankester 2010, Joly and Messier 2004).

Population trends for Shiras moose (*A. a. shirasi*), which occur in the Pacific Northwestern USA and Canada, have been highly variable in recent decades. Populations in Washington and some parts of Idaho have increased (IDFG unpublished data, Muir 2006, Harris 2015), while populations in many states including some in Idaho (IDFG unpublished data), Montana (DeCesare 2014), and Wyoming (Oates et al. 2016) have experienced marked declines. A number of population drivers have been examined nationwide, including forage quality (McArt et al. 2009), predation (Mech and Fieberg 2014, Dussault et al. 2005), parasites and disease (Lankester and Samuel 2007), physiological tolerance to temperature (Lenarz et al. 2009), and indirect effects of climate change on plant phenology (Monteith et al. 2015). However, the mechanisms driving these processes and how they affect survival and reproduction, and ultimately population growth or decline, are not well understood for Shiras moose.

Declines in forage availability and quality could be contributing to declining population trends for some Shiras moose populations in Idaho. Changing forest management practices and continued fire suppression has resulted in advancing forest succession, which could alter forage quality and quantity, especially on national forest lands. However, information on moose diet selection and forage quality and availability necessary for a rigorous test of this hypothesis is limited. Objectives of this study were to fill this information gap for moose populations in northern Idaho by 1) evaluating diet composition and selection, 2) assessing forage quality parameters, 3) estimating forage quantity and quality across the landscape, 4) estimating changes in forage quantity and quality across 30 years, and 5) interpreting results in the context of population indices to evaluate the degree to which forage could be limiting declining populations. We predicted that individuals would select forage species that were both highly available and high in quality because moose are large-bodied, selective browsers that likely need to balance selection for quality with attaining adequate quantity. We also predicted that indices of population trend and productivity would be positively correlated with the current amount of quality forage and the change over time in the amount of quality forage. This information will provide a foundation for evaluating whether forage limitations could be affecting moose population dynamics in northern Idaho. Such knowledge can be used to shape forest management strategies and harvest recommendations, and to direct future research into proximate factors influencing Shiras moose throughout their range.